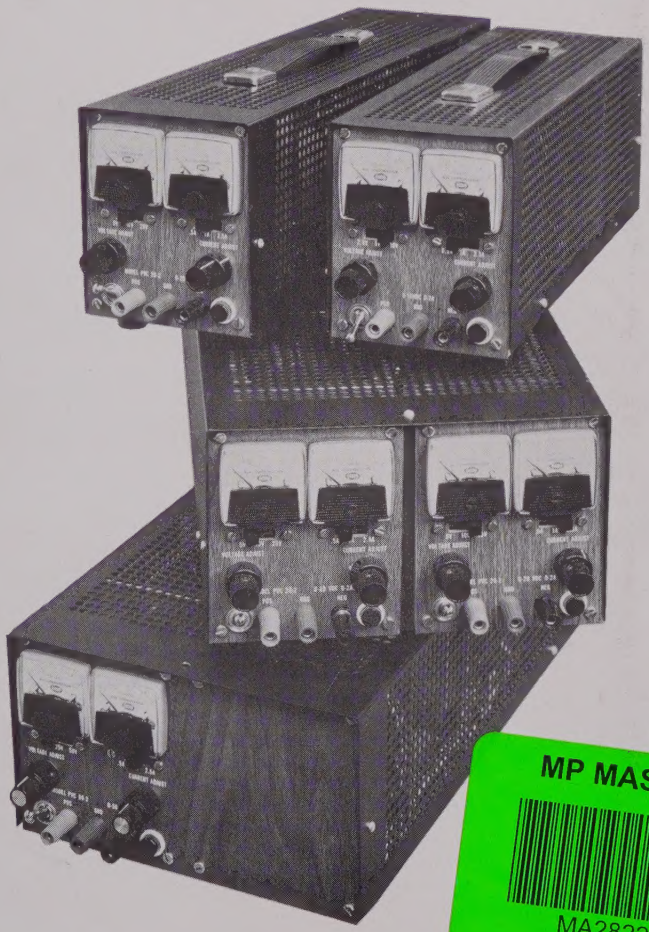
PVC/LVC II

INSTRUCTION MANUAL

Sn. A-50

MODEL NO. LVC50-0.5



MP MASTER
MA28223

NJE CORPORATION

INSTRUCTION MANUAL
FOR

NJE MODEL LVC -50-0.5

SERIAL NO. _____

NJE CORPORATION
Electronic Development & Manufacturing
Kenilworth, New Jersey 07033 / (201) 272-6000
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A subsidiary of CONDEC Corporation

802-440

WARNING

THIS EQUIPMENT EMPLOYS VOLTAGES WHICH ARE DANGEROUS AND CAN BE FATAL IF CONTACTED BY OPERATING PERSONNEL. EXTREME CAUTION MUST BE EXERCISED WHEN WORKING WITH THIS EQUIPMENT.

INTRODUCTION

DEVIATIONS:

This manual covers the Standard NJE Power Supplies as indicated in Section I herein. Where deviations to the specifications are built into equipment at the customer's request, the nature of the deviation as it affects this manual is indicated in a Specification Sheet which precedes Section I. If special Schematic Diagrams, Parts Placement Drawings and/or Spare Parts List (s) are required for the deviation they will be found in Section V of the manual, in place of, or along with the Standard material.

CORRESPONDENCE:

All correspondence must reference the complete description of the unit as shown on the identification label located at the rear of the power supply.

In requesting Spare Parts or information relative to parts, the Reference Designation, the rating, the description, and the NJE Part Number must be specified for each part in question.

DESIGN IMPROVEMENTS:

NJE Corporation reserves the right to make design improvements on any instrument without prior notice.

REPRODUCTION:

No written material, drawings, text figures, or any part of this Instruction Manual may be reproduced without express written consent of NJE Corporation.

REPAIR SERVICE

NJE Corporation provides complete repair facilities at the main plant and at local service centers as listed in the rear of the manual. These repair facilities are adequately staffed with factory trained technicians to assure our customers of the most knowledgeable and expedient servicing of our equipment. All equipment forwarded to these facilities must be adequately packaged to prevent damage in transit.

OUT OF WARRANTY SERVICE:

Forward defective equipment to factory or local service center prepaid. A full description of difficulties encountered or the repair required should accompany this shipment. An estimate of the cost of repair will be submitted to you. The necessary servicing will be performed only upon receipt of your written service orders. Your equipment will be returned to you via collect shipment unless otherwise specified on your service order.

IN WARRANTY SERVICE:

If, during the warranty period the power supply indicates an inherent defect, immediately communicate with your nearest NJE Field Representative in your area. If, after examination, he concurs that the unit is defective under the warranty conditions, he will provide written authorization for the return of the unit to the factory or the local field service center, whichever is nearer. NJE Corporation will not assume any transportation charges on incoming equipment without the concurring written approval from its field representative.

SECTION I

SPECIFICATIONS

1.1 GENERAL:

The LVC Line of compact Bench or Quarter-Rack Series Regulated Power Supplies is designed for use in applications requiring a well regulated stable source of D-C power. The specifications herein are tabulated (See Table 1-1) where ratings change from model to model and are generalized into paragraphs where ratings are common.

1.2 GENERAL ELECTRICAL SPECIFICATIONS:

1.2.1 Input: 105 to 130 volts, 47 to 420 Hertz single phase at approximately 0.5 Amperes (approximately 1.0 Amperes for 2LVC units).

1.2.2 Output Voltage and Current: See Table 1-1.

1.2.3 Static Voltage Regulation:

1.2.3.1 Load: At constant input voltage, the regulation for load changes is less than 0.01% plus 1 millivolt from no load to full load.

1.2.3.2 Line: At constant load, the regulation is less than

0.01% plus 1 millivolt from 117 Volts to 105 Volts and less than 0.01% plus 1 millivolt from 117 Volts to 130 Volts.

1.2.4 Static Current Regulation:

1.2.4.1 Load: At constant input voltage, the regulation for load changes is less than 1.0% plus 10 Milliamperes from 10% load to full load.

1.2.4.2 Line: At constant load, the regulation is less than 0.5% plus 10 Milliamperes from 117 Volts to 105 Volts and less than 0.5% plus 10 Milliamperes from 117 Volts to 130 Volts.

1.2.5 Mode of Operation: Constant current and constant voltage levels may be preset within the maximum ratings specified in Table 1-1. Referring to the graph (Figure 1-1) the intersection of the constant voltage and constant current operation lines, called the Crossover Point, may be located anywhere within the output

volt-ampere rating of the unit. Regardless of the demands of the load, the output voltage and/or the output current will never exceed the limits preset by the output voltage and current controls.

1.2.6 Ripple: 250 Microvolts rms from D-C to 10 Megahertz.

1.2.7 Transient Response: For a no load to a full load or a full load to no load step change, the output voltage will return to within 10 millivolts of the regulated region in less than 50 microseconds.

1.2.8 Meters: Three range Voltmeter and dual range Ammeter accurate to 3% of full scale value are provided on the front panel.

1.2.9 Polarity: The output may be floated up to 500 volts peak above ground. Either polarity may be grounded to chassis by means of terminals provided.

1.2.10 Duty: Continous at ambient temperatures from 0°C to 60°C.

1.2.11 Remote Sensing: Sensing Terminals separate from the load terminals provide sensing at load regulation against the voltage at the load rather than the voltage at the power supply output terminals. This eliminates the otherwise unavoidable load regulation due to the voltage drop in the wires connecting the supply to the load. This feature does not eliminate voltage excursions resulting from load transients through the load line impedance.

1.2.12 Remote Programming: The output voltage may be controlled accurately from a remote point by varying the resistance across the Remote Program terminals. The sensitivity of this circuit is approximately 100 ohms per volt.

1.2.13 Multi-unit cross-connection:

1.2.13.1 Series operation: Two or more units may be operated in series to provide higher output voltage at rated current. Each unit functions independently.

1.2.13.2 Parallel operation: Two like units may be operated in parallel to provide twice the rated current of a single unit. Master-slave operation with single output control is provided.

1.2.13.3 Tracking: Two or more units may be connected in series, parallel or with one common voltage point and controlled with a single output control and referenced to one supply's reference voltage. This connection requires the addition of tracking resistors and is discussed in Section II under Installation and Operation.

1.2.14 Termination: A barrier type terminal strip at the rear of the unit provides interface connection for output, remote sensing, remote programming, tracking and grounding. Input line cord with three prong, in-line safety plug is provided. Front panel binding posts for output and ground are

provided in addition to the output terminals at the rear.

1.2.15 Protection: Load and power supply protection for any overload condition is provided by the current limiting inherent in the automatic crossover-constant current design. Protective fuse will interupt input power in the event of internal failure.

1.2.16 Resolution: Continously variable Coarse and Vernier Output Voltage Adjust potentiometers provide the resolution indicated in Table 1-1.

1.3 Mechanical Specifications:

1.3.1 Outline Drawing: Figures 1-2 through 1-4 show appropriate outline and interface information.

1.3.2 All units are designed for convection cooling. Airflow paths shown in appropriate outline drawing must not be blocked.

1.3.3 Mounting: Units are designed for bench mounting. Rack adapters are available per paragraph 1.4.

1.3.4 Finish: Chassis has clear satin finish. Panel Marking and dust-covers are black. All other finishes are appropriate paint, plating or chemical film.

1.4 Optional features:

1.4.1 Rack adapters:

1.4.1.1 NJE Model RP101 rack adapter to mount up to 4 LVC or two 2LVC units in standard 19 inch wide rack panel 5-1/4 inches high.

1.4.1.2 NJE Model RP102 rack adapter same as RP101 above except that chassis slides are provided.

1.4.1.3 NJE Model RP103 rack adapter economy model slide adapter

for use with RP101. Adds 1-3/4 inch to height.

1.4.1.4 NJE Model CP101 cover plate. Order one or more, as required to cover unused positions in rack adapters

1.4.1.5 NJE Model DC101 Single unit dust cover for use with rack adapters, (Supplied automatically when units and rack adapters are ordered together but must be ordered separately for field assembly).

1.4.1.6 NJE Model DC102 Dual Unit dust cover for use with rack adapters. (Supplied per paragraph 1.4.1.5 above)

1.4.2 Overvoltage Protection Options:

1.4.2.1 NJE Model OVPA: Addition of over-voltage protection circuit which will "Crowbar" the output terminals when a pre-set voltage level is exceeded. Crowbar voltage may be set, by means of adjustment available from the rear of the unit over the range of from 3 volts to 10% above maximum rated voltage of the Power Supply.

1.4.2.2 NJE Model OVPB: Same as OVPA Option except that adjustment is provided on the front panel. Output voltage Adjust Vernier is removed for this option therefore, Option TTV or TTVL as specified below should also be ordered when this option is desired.

1.4.3 Ten Turn Control Options:

1.4.3.1 TTV Option: Replacement of Coarse Output Voltage Adjust with ten-turn potentiometer.

1.4.3.2 TTVL Option: Same as TTV option above except that decade dial and lock are provided.

1.4.3.3 TTC Option: Replacement of Current Adjust with ten-turn potentiometer.

1.4.3.4 TTCL Option: Same as TTC option above except that decade dial and lock are provided.

1.4.3.5 TTOV Option: Replacement of front panel Overvoltage Control of OVPB option with ten-turn potentiometer.

1.4.3.6 TTOVL Option: Same as TTOV option above except that decade dial and lock are provided.

1.4.4 OVT Option: Addition of internal thermal cutout which will cut off the power supply if the internal temperature reaches an unsafe level.

1.5 Model Buildup and Ordering Information:

1.5.1 Examples of correct specification of LVC Models and Options are shown below:

1.5.1.1 For Model LVC 50-0.5 with ten-turn locking Voltage control and Overvoltage without front panel adjust order NJE Model LVC 50-0.5-TTVL-OVPA.

1.5.1.2 For Model LVC 20-1 with ten-turn Current adjust and Model 2LVC 10-2 with ten-turn Voltage Adjust mounted on a Rack adapter order NJE Model LVC20-1-TTC-DC 101; NJE Model 2 LVC 10-2-TTV-DC102; NJE Model RP101; NJE Model CP101.

1.5.2 Special Assemblies

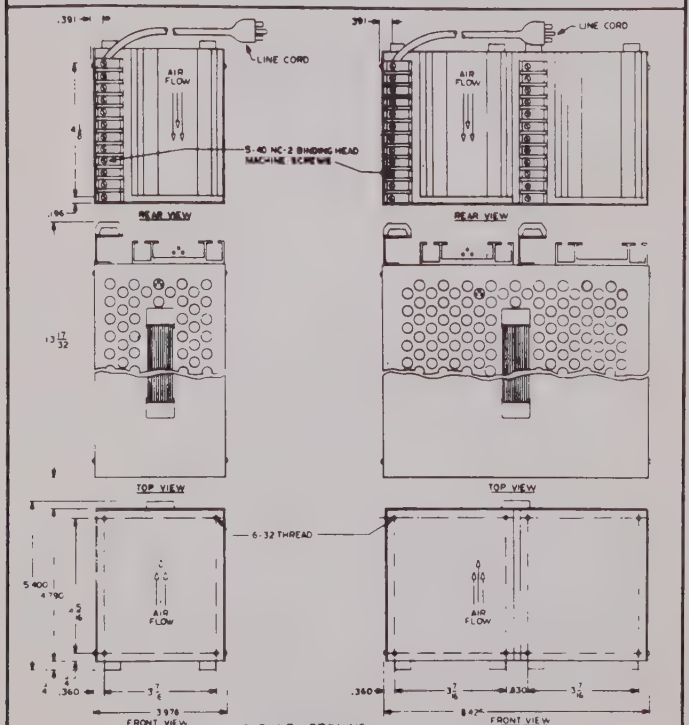
1.5.2.1 If it is desired to obtain two different LVC models mounted in the same manner as the 2LVC units with a single line cord, this is available by ordering as follows: For NJE Model LVC50-0.5 and NJE

Model LVC 10-2 mounted in the dual dust-cover order NJE Model LVC50-0.5/LVC10-2.

MODEL NO.	VOLTAGE	CURRENT	RESOLUTION	WEIGHT
LVC-10-2	0-10V	0-2A	3MV	11 lb. 5 Kg.
LVC-20-1	0-20V	0-1A	5MV	
LVC-50-0.5	0-50V	0-0.5A	7MV	
2LVC-10-2	DUAL 0-10V	0-2A	3MV	22 lb. 10 Kg.
	0-10V	0-4A		
	0-20V	0-2A		
2LVC-20-1	DUAL 0-20V	0-1A	5MV	
	0-20V	0-2A		
	0-40V	0-1A		
2LVC-50-0.5	DUAL 0-50V	0-0.5	7MV	
	0-50V	0-1A		
	0-100V	0-0.5A		

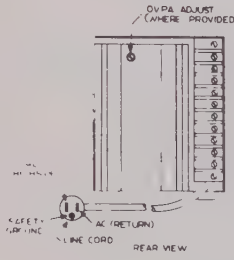
TABLE 1-1

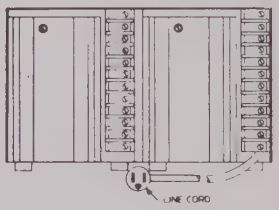
TABULATED SPECIFICATIONS

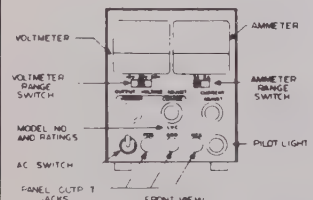


NJE CORPORATION KENILWORTH, N. J.	SIZE	CODE IDENT NO.	DWG NO.
		98380	112137
	SCALE	REV	SHEET

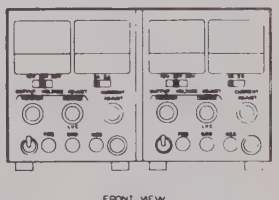
TB1 TERMINAL BOARD LEGEND			
TERM NO	SCREENED FUNCTION	RECOMD WIRE SIZE	REMARKS
1	SENSE POS OUT	NO 20 AWG	NORMALLY JUMPED TO POS OUT
2	GRD		
3	OUT		CONNECT TO POS OR NEG OUT IF DESIRED
4	NEG SENS		NORMALLY JUMPED TO NEG OUT
5	TRACK		
6	COM		NORMALLY JUMPED TOGETHER
7	RMTE PROG		
8			
9	PAR OPER	NO 20 AWG	NORMALLY JUMPED TOGETHER
10	COM		







LVC TYPE

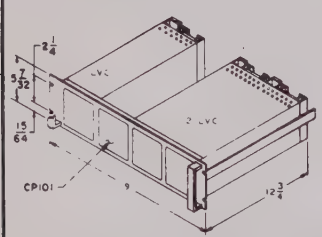


2 LVC TYPE

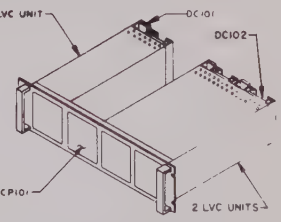
INTERFACE DRAWING
LVC UNITS

FIGURE 1-3

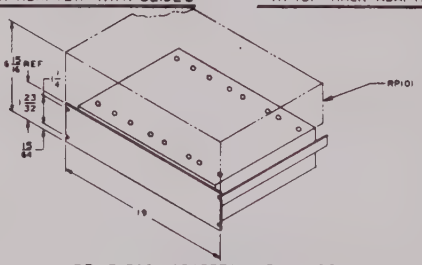
NJE CORPORATION KENILWORTH, N. J.	SIZE	CODE IDENT NO. 98380	DWG NO. 112138
	SCALE	REV	SHEET



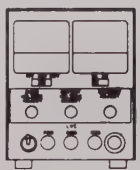
RP102 RACK ADAPTER WITH SLIDES



RP101 RACK ADAPTER

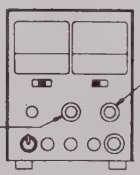


RP103 RACK ADAPTER WITH SLIDES



OVPB & TTOV

NOTE
WHERE TTVL TTCL OR TTOVL ARE SPECIFIED THE CONTROL IN QUESTION HAS DECADE DIAL AND LOCK



TEN TURN OPTIONS
FIGURE 1-4

NJE CORPORATION KENILWORTH, N. J.	SIZE	CODE IDENT NO.	DWG NO.
		98380	112139
	SCALE	REV	SHEET

SECTION II

INSTALLATION AND OPERATION

2.1 UNPACKING: The power supply is shipped in a corrugated carton which is floated on sufficient insulation in a heavy-duty shipping carton. Aside from normal precaution against damage to the unit in opening the cartons and removing the unit no special procedures are required. The carton should be opened immediately upon receipt and the contents inspected for shipping damage. The power supply was checked electrically and mechanically before it left the factory, and is warranted to be in perfect operating condition. This warranty does not cover possible damage incurred during shipment. Therefore, any evidence of mishandling, such as broken, deformed or missing parts, should be brought to the attention of the transportation company, and a claim should be entered. Remove top cover-plate and inspect all components and wiring, both on the chassis panel as well as the mechanical condition of the housing. The literature packed with the supply should be removed and held for reference in operating the equipment.

2.2 INSTALLATION: Refer to Section which indicates which Outline Drawing is to be followed for the model in question. This Outline Drawing shows mounting dimensions, air flow requirements, interface wiring information and other data pertinent to proper installation. Careful observance of all the specification requirements in Section I is essential to a proper installation. READ THE SPECIFICATIONS CAREFULLY BEFORE PROCEEDING.

When the unit has been properly placed in position or mounted in its rack and secured in place by the panel screws, electrical connections should be made in accordance with the following step-by-step procedure. Wire sizes to be used and the terminal locations are specified on the appropriate Outline Drawing of Section 1-3. Terminal functions listed in the following instructions are clearly screened on the equipment itself, as well as being indicated on both the outline of Section 1-3 and the Schematic Diagram of Section V.

2.3 STANDARD SINGLE UNIT ELECTRICAL INSTALLATION:

2.3.1 Output Grounding: Connect either the positive (POS OUT) or negative (NEG OUT) DC output terminal of the supply (depending upon desired output polarity) directly to the chassis ground terminal (GRD) at the barrier strip on the rear of the chassis, and connect the ground terminal to the system ground.

NOTE: If it is necessary that the power supply circuit float above or below ground, it is recommended that the output terminal should be connected to the chassis ground terminal by a 0.1 microfarad 600VDC capacitor in place of the direct connection. Use of this by-pass capacitor will improve the stability of the circuit in the ungrounded condition, and reduce the effect of external interference and hum. Refer to Polarity Specification in Section I for maximum limitation on floating voltage permitted.

2.3.2 Output Connection: Connect the positive and negative output terminals (POS OUT) and (NEG OUT), respectively to the corresponding terminals of the external load. Use heavier gauge wire than that specified if long distances to the load are involved.

2.3.3 Remote Sensing: All units are shipped from the factory with the REMOTE SENSING feature jumpered out on the inter-connection terminal board as follows: (POS SENS) connected to (POS OUT) and (NEG SENS) connected to (NEG OUT). With this connection, the regulation specifications are met ONLY at the output terminals of the supply. If it is desired to have accurate regulation at the remote load point, rather than at the output terminals, proceed as follows:

Connect the output terminals to the load per Paragraph 2.3.2 above. Remove the Jumpers from (POS SENS) to (POS OUT) and (NEG SENS) to (NEG OUT) respectively.

Observing correct polarity, run a twisted pair of No. 20 AWG wire (or larger) from (POS SENS) to the positive load point and from (NEG SENS) to the negative load point.

WARNING: DO NOT OPERATE POWER SUPPLY WITHOUT THE SENSING LEADS CONNECTED EITHER REMOTELY OR LOCALLY. MOST CUSTOMER COMPLAINTS OF POOR OPERATION ARE DUE TO IMPROPER SENSING LEAD CONNECTION.

WHEN THE POINT OF REMOTE SENSING IS MORE THAN 10 FEET FROM THE POWER SUPPLY, OSCILLATIONS MAY DEVELOP. A POSSIBLE CURE IS TO CONNECT REMOTE CAPACITANCE AS CLOSE TO THE POINT OF SENSING AS IS PHYSICALLY POSSIBLE.

2.3.4 Remote Programming: To utilize the Remote Voltage Programming, remove the jumper from TB1-7 (COM) and TB1-8 (RMTE PROG) and connect the appropriate resistance between terminals TB1-7 (COM) and TB1-5 (NEG SENS). If the resistor is to be located remotely from the power supply, a twisted pair of

No. 20AWG should be used. The resistance of the Remote Program resistor may be determined readily by multiplying the desired output voltage by the Remote Programming sensitivity specified in Paragraph 1.2.12.

2.3.5 Input connection: Each unit is provided with a 3-wire line cord and 3-prong in-line safety plug. This provides automatic grounding of the chassis to the system ground when plugged into a standard 117 volt outlet. If it is desired to wire input in some other manner, that is removing the plug, be sure to observe the color coding of the input cord which is the same as conventional electric codes. When rewiring without using the plug; wire Black wire to "high" side of line; white wire to "return" and Green wire to system or frame ground.

2.3.6 Dualling: The LVC units may be operated in many configurations where series, parallel, single-

reference tracking, etc. are required. Figures 2-1 through 2-5 show the connection of most of the common dualling possibilities. For configurations not shown, consult the factory for application engineering assistance.

2.4 OPERATION:

2.4.1 The following check list should be followed before making the unit operational:

2.4.1.1 AC power switch in the off position.

2.4.1.2 VOLTAGE ADJUST potentiometer in the extreme counter-clockwise position.

2.4.1.3 CURRENT ADJUST potentiometer in the extreme clockwise position.

2.4.1.4 Input wiring made per Paragraph 2.3.6.

2.4.1.5 Output Grounding wired per Paragraph 2.3.1.

2.4.1.6 Output wiring made per Paragraph 2.3.2.

2.4.1.7 Remote Sensing wiring made per Paragraph 2.3.3.

2.4.1.8 Remote Programming wiring made per Paragraph 2.3.4.

2.4.1.9 Dualling connection (where desired) made per Paragraph 2.3.6.

2.4.2 Step-by-step operation based on the location of controls as indicated on the outline drawing specified in Table 1-1.

2.4.2.1 Energize the AC line.

2.4.2.2 Operate the AC power switch to the ON position. The pilot lamp should light.

2.4.2.3 While monitoring both output voltage and current, slowly rotate the VOLTAGE ADJUST potentiometer clockwise until the desired voltage level is reached.

2.4.2.3.1 If the desired voltage and/or current level (within the ratings of the unit) cannot be reached, de-energize the AC line

and recheck all connections per Paragraph 2.4.1. If still unable to achieve the desired levels, refer to the Troubleshooting Section at the rear of the manual.

2.4.2.4 CURRENT ADJUST may be set to the desired level as follows:

2.4.2.4.1 Method #1: While monitoring the load current, apply a short circuit across the load and rotate the CURRENT ADJUST potentiometer counter-clockwise, until the desired current level is reached.

Method #2: While monitoring the load voltage and current, adjust the load so that the desired levels are reached. Rotate the CURRENT ADJUST potentiometer(s) slowly counter-clockwise until the current level begins to fall off.

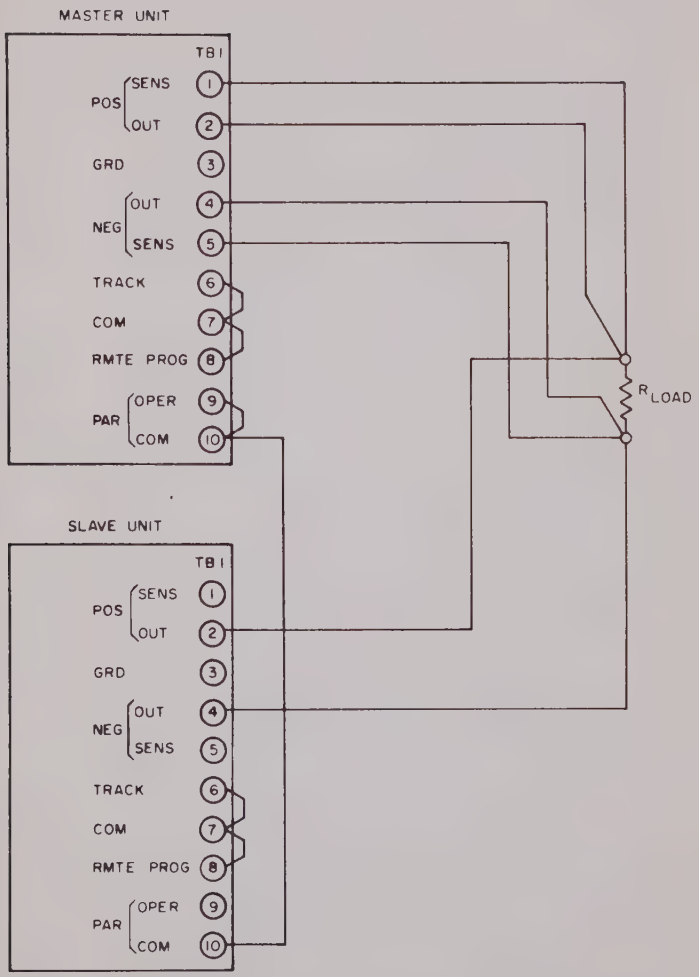


FIGURE 2-1
INTERCONNECTION FOR PARALLEL CONFIGURATION

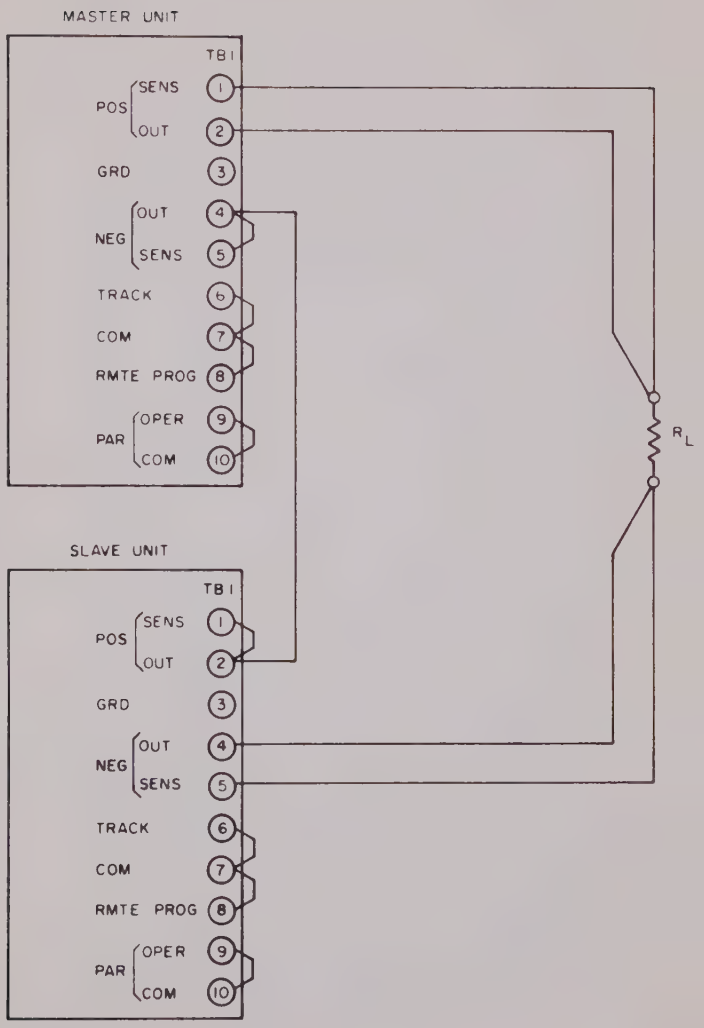


FIGURE 2-2

INTERCONNECTION FOR SERIES CONFIGURATION

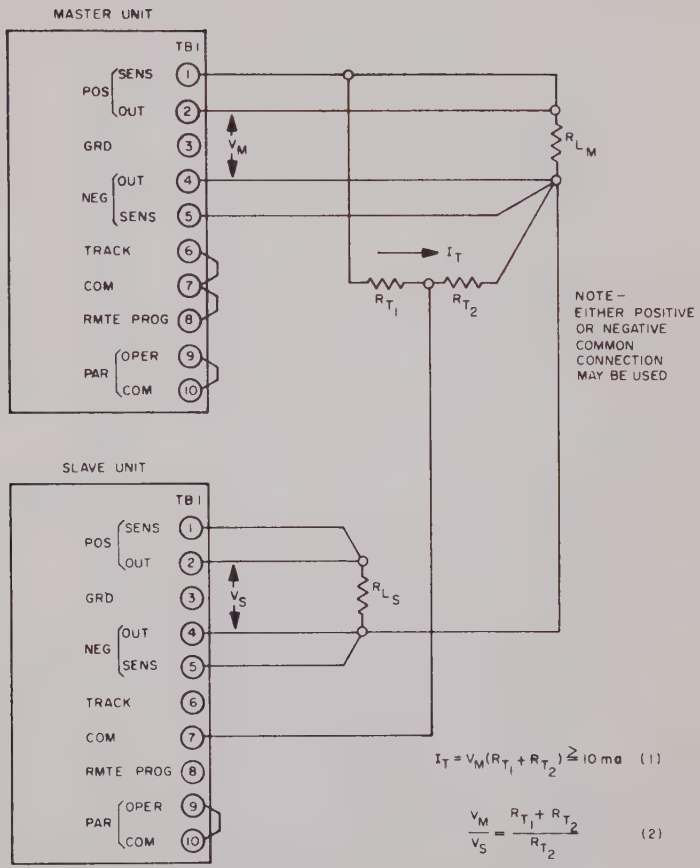
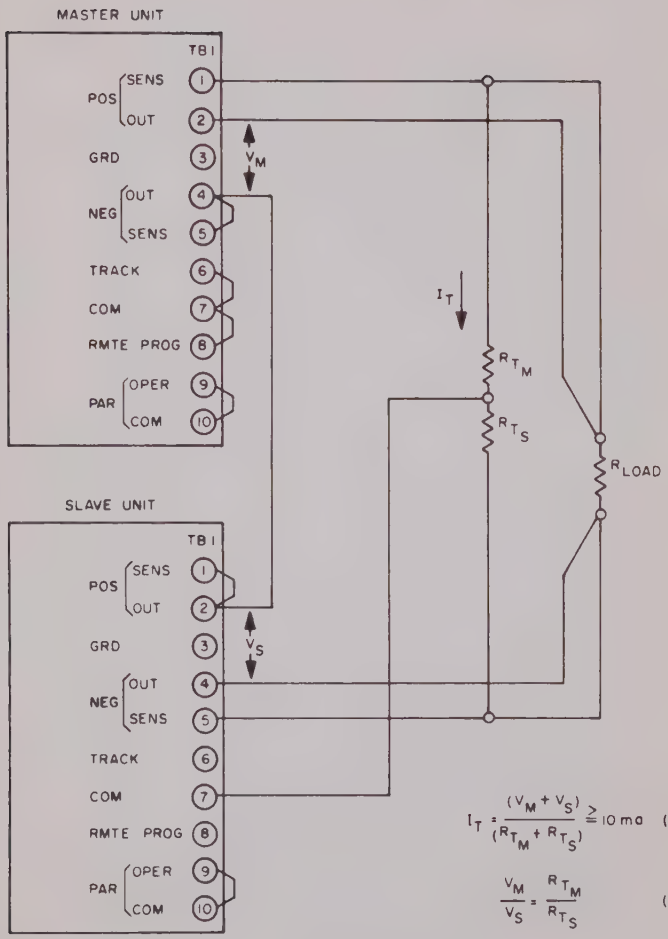


FIGURE 2-3

INTERCONNECTION FOR COMMON TRACKING CONFIGURATION



$$I_T = \frac{(V_M + V_S)}{(R_{T_M} + R_{T_S})} \geq 10\ ma \quad (1)$$

$$\frac{V_M}{V_S} = \frac{R_{T_M}}{R_{T_S}} \quad (2)$$

FIGURE 2-4

INTERCONNECTION FOR SERIES TRACKING CONFIGURATION

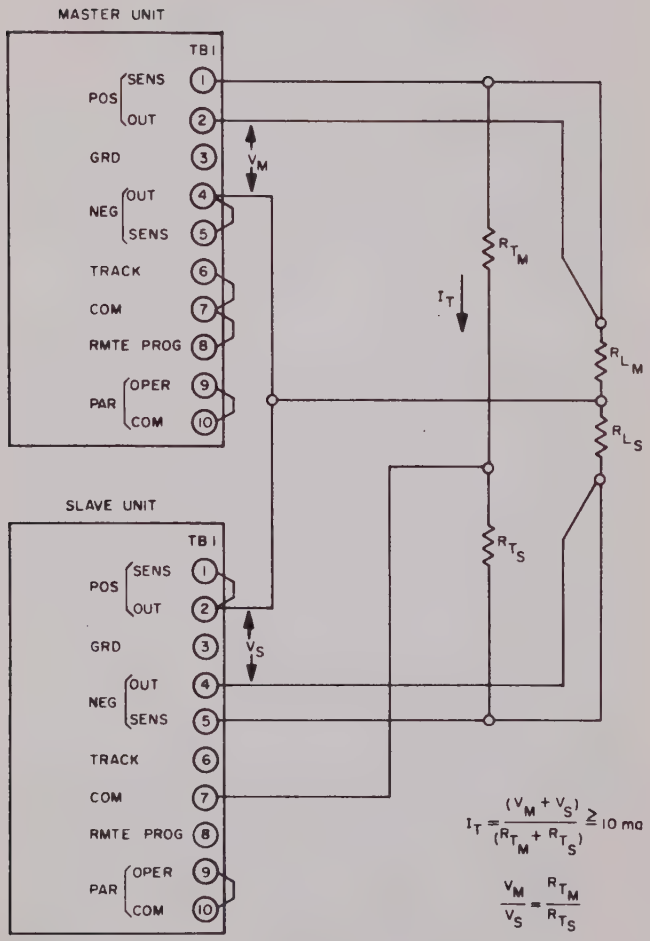


FIGURE 2-5

INTERCONNECTION FOR PLUS & MINUS TRACKING CONFIGURATION

SECTION III

PRINCIPLES OF OPERATION

GENERAL: A simplified block diagram illustrating the basic elements of the circuit and the signal flow is shown in Figure 3-1. The A-C line voltage is converted to a practical value by the power transformer and rectified by a full-wave diode rectifier. A capacitor-input filter smooths the pulsating D-C output of the rectifier, providing a low-ripple, unregulated voltage to the output regulator or Pass Transistor. The output voltage furnished to the load by the regulator is monitored by a feedback amplifier which compares this output voltage to the stabilized reference voltage and amplifies the difference between these two voltages. The output of the amplifier is used to control the regulator in such a manner as to counteract any change in the D-C output voltage, thereby furnishing an essentially constant voltage to the external load, despite variations in input line voltage or output load current. The voltage across the current sensing resistor is monitored by another amplifier and when this voltage, which is proportional to the output current, exceeds the pre-set value, the current amplifier over-rides the voltage amplifier causing the power supply to cross over from constant voltage mode to constant

current mode of operation.

DETAILED CIRCUIT DESCRIPTION: Circuit references in the following material apply to the schematic diagram at the rear of the manual. This diagram shows electrical relationships without regard to actual physical location of the components and is laid out in an arrangement approximately the same as that of the block diagram, Figure 3-1.

The power supply is energized by connecting the line cord to a 117V (nominal) power source and closing switch (S1) attested to by the lighting of pilot lamp (DS1).

The power transformer (T1) converts the primary line voltage to an appropriate value on its main secondary (terminals #6, 8 and 10) which is fed into rectifier diodes (A1CR5) and (A1CR8) providing a pulsating D-C voltage which is smoothed by filter capacitor (A1C3) and applied through regulator transistor (Q1) to the external load. Capacitor (A1C11) in series with resistor (A1R30) provide additional filtering and reduces the internal impedance for high-frequency load variations. Resistor (A1R34) provides a bleed-off for residual charges on capacitor (A1C3).

The regulated reference voltage supply gets its input from auxilliary secondary winding (terminals #3, 4 and 5) of main transformer (T1). This

voltage is rectified by diodes (A1CR1) and (A1CR2) providing a pulsating D-C voltage which is smoothed by filter capacitor (A1C1) providing a low-ripple, unregulated voltage to the reference voltage regulating transistor (A1Q1). The output of this regulating transistor is fed to its load, potentiometer (A1R10), and additional filtering is provided by capacitor (A1C6). A portion of the voltage across (A1R10) is fed into the base of transistor (A1Q5) where it is compared with voltage of reference diode (A1CR4) at the base of transistor (A1Q4). The difference between these two voltages is fed through another stage of balanced amplification consisting of (A1Q2) and (A1Q3) and their associated load resistors thence to the base of regulating transistor (A1Q1) thereby controlling the voltage at (A1R10) making it essentially constant regardless of variations in the input voltage or load current demand.

The main voltage correction amplifier functions in a manner quite similar to that of the reference supply circuit. A voltage divider consisting of resistor (A1R18) coming from the positive end of the reference voltage supply, front panel VERNIER and COARSE OUTPUT VOLTAGE ADJUST potentiometers, R2 and R3, returned to the Negative sensing point provides a voltage which is proportional to the output voltage. A portion of this voltage is fed

to the base of transistor (A1Q13) and compared to the voltage at the base of transistor (A1Q12). The difference between these two voltages is then amplified by balanced stage (A1Q10) and (A1Q11) and their associated load resistors and emitter-follower drivers (A1Q9) and (A1Q6) which control the pass transistor (Q1).

Capacitor (A1C10) and resistor (A1R29) act as a bypass for the input divider to assist in response to rapid changes in load requirements. Networks (A1C7) - (A1R17) and (A1C9) - (A1R22) provide proper high-frequency roll-off to stabilize the voltage amplifier. Diodes (A1CR13) and (A1CR14) protect the amplifier first stage against accidental opening of the sensing leads. Resistor (A1A1R1) provides pre-load for proper operation at light load conditions.

Automatic crossover into constant current mode of operation is provided when the output current exceeds a value pre-set by the front panel CURRENT ADJUST potentiometer (R1). The basic method of operation is to provide an over-ride signal to the base of driver transistor (A1Q6 when this condition occurs. The actual operation of the circuit is as follows:

Since transistor (A1Q8) has its emitter connected through blocking diode (A1CR12) to the base of driver transistor (A1Q6), in-

creased conduction of (A1Q8) will cause the base of (A1Q6) to go more negative, thereby tending to cut it off. This will, in turn, cause less current to go through the main pass transistor (Q1) thereby reducing the current in the load. Since the reverse is true, that is a decrease in the conduction of (A1Q8) will allow more current to flow through (Q1), current regulation is accomplished by controlling the conduction of (A1Q8).

The conduction of (A1Q8) is controlled by (A1Q7) to which it is directly coupled. (A1Q7) has its base voltage level (and thereby its turn on point) set by means of a voltage divider network consisting of front panel CURRENT ADJUST potentiometer (R1), fixed resistor (A1R12) and CURRENT LEVEL SET potentiometer (A1R13) all connected across regulator diode (A1CR10). *This divider is connected from the positive end of the current sensing resistor (A1A1R12) through resistor (A1R14) to the negative return at (A1C4). The junction of (A1R12) and (A1R13) is fed to the base of transistor (A1Q7) thereby providing a base voltage that is proportional to the voltage across regulator diode (A1CR10). Thus, the threshold of over-ride action can be set by means of potentiometer (A1R13) and the actual

*10V and 20V units have (A1R14) replaced by a preregulator consisting of (A1A1CR1), (A1A1R3) and (A1A1R4

point of crossover by means of the CURRENT ADJUST potentiometer (R1). Since the base of (A1Q7) is referenced to one side of the current sensing resistor (A1A1R2) and its emitter is connected through temperature compensating diode (A1CR11) to the other side of (A1A1R2), any change in the voltage across (A1A1R2) will change the level at the emitter of (A1Q7) relative to its base thereby adjusting the current through the main pass transistor (Q1) which in effect accomplishes current regulation at the load. (A1R15) sets the proper current level through temperature compensating diode (A1CR11), resistor (A1R16) serves as a base-isolation resistor for (A1Q7) and capacitor (A1C5) introducing negative feedback to stabilize the current regulating amplifier.

The output metering circuits are conventional, providing a three range voltmeter (M1) with its multipliers (A1R31), (A1R32) and (A1R33) and range switch (S2) and a two range ammeter (M2) with built-in shunts and range switch (S3).

OVERVOLTAGE PROTECTION CIRCUIT: When provided as an option, the overvoltage protection circuit allows protection against excessive voltage excursion beyond any pre-set value within the ratings of the overvoltage protection circuit. When this pre-set voltage is exceeded, the overvoltage protection

circuit senses this fact and fires a Silicon Controlled Rectifier which "crowbars" the output down to a value approaching zero volts. The supply remains in this condtion until the A-C line fuse blows approximately one second after the firing of the crowbar circuit. Reset is accomplished by replacing the fuse, removing the cause of the excessive voltage and then re-energizing the power supply. The circuit functions as follows:

The output voltage is sensed by a divider network consisting of potentiometer (R2)* and fixed resistors (R5) and (R9) and a portion of this voltage is fed into the base of transistor (Q3). A reference is established by means of reference diode (CR1) and a portion of its voltage is fed into the base of transistor (Q4) through potentiometer (R7) where it is compared to the voltage at the base of transistor (Q3). The difference between these two voltages appears across resistor (R6) whereby it is fed to triggering transistors (Q1) and (Q2). The triggering of these two transistors causes the gate of Silicon Controlled Rectifier (CR2) to fire thus placing a short across the output of the supply. Resistor (R1) is connected to the positive unregulated point of the power supply to provide sustaining

voltage so that the crowbar will remain on even though the output voltage approaches zero. Resistor (R4) serves to limit the short circuit current through the SCR to a safe peak value. Capacitor (C1) introduces sufficient delay on turn-on so that no false firing occurs. The balance of the capacitors serve to prevent misfiring due to random induced spikes from circuits other than the power supply output. Resistor (R8) serves as a gate isolating resistor and resistors (R3), (R10), (R11) and (R12) serve as load resistors for their respective transistors.

* All reference designations refer to those of the overvoltage option circuit card and should not be confused with those of the main schematic diagram for the power supply.

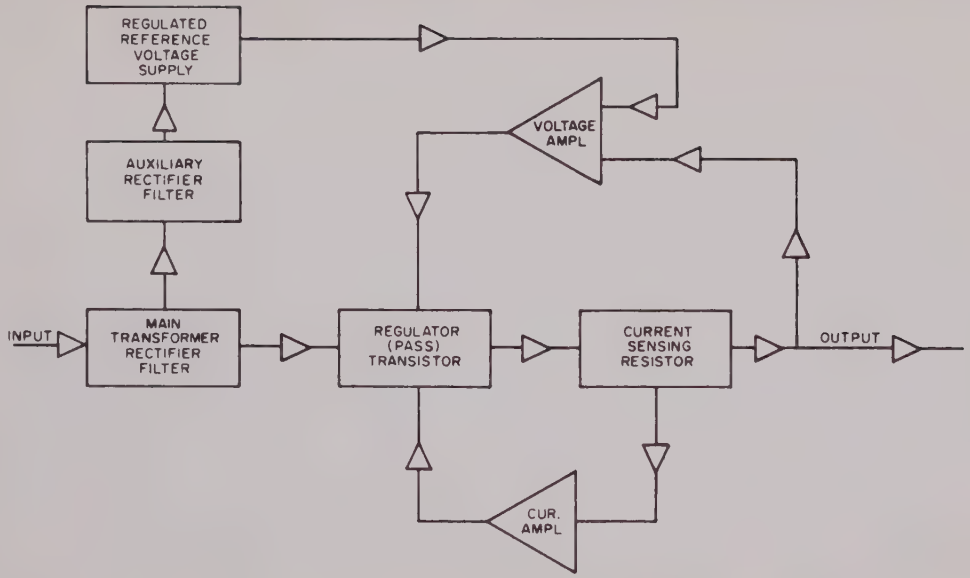


FIGURE 3-1

SIMPLIFIED BLOCK DIAGRAM

SECTION IV

MAINTENANCE

4.1 GENERAL: Reference drawings for this power supply are provided in Section V. The exact Schematic Drawing is shown in Figure 5-1. Physical location of components is indicated in the Parts Placement Drawing in Figure 5-3.

This supply is designed for stable operation over long periods of time. However, if trouble develops, standard test equipment normally found in the Electronics Laboratory would be required. If the customer decides to do complete servicing on his premises, one or more of the following pieces of test equipment are required:

4.1.1 INSTRUMENTS REQUIRED:

- 4.1.1.1 DC Differential Voltmeter with range of 0-500V for Precise Regulation check.
- 4.1.1.2 Oscilloscope, general purpose for general troubleshooting.
- 4.1.1.3 Vaccuum Tube Voltmeter, general purpose for Ripple measurements.
- 4.1.1.4 Multimeter (Ohmmeter) for general troubleshooting.

4.1.1.5 AC Voltmeter (precision) with range of 0-150V for precise regulation check.

4.1.1.6 Variable Autotransformer as per input rating for general troubleshooting.

4.1.1.7 Dummy Load - range depends on supply rating.

WARNING !!!

THE POWER SUPPLY SHALL BE DE-ENERGIZED WHENEVER ANY COMPONENTS ARE REPLACED.

4.2 MEASUREMENTS AND TESTS:

4.2.1 Sensing Connection: Sensing lead connections are of utmost importance in making proper regulation measurements. It is recommended that the sensing connections be made directly at the output terminal points rather than at a remote load point. Although the regulation measurement should check correctly at a remote point as well as at the supply terminals, it is well to ascertain that the power supply itself is operating properly without introducing the possibility of extraneous external wiring problems. Thus, all measurements should be made with "local" sensing connections, i.e., with the sensing terminals jumpered directly to the corresponding output terminals. One other point of caution in proper measurement technique is the following:

It is absolutely essential that the measuring equipment connections be made directly to

the sensing terminals, whereas the load lead connections must be made directly to the output terminals. Figure 4-1 shows proper and improper connections for measurements taken with "local" and "remote" sensing connections.

Various measurements can be made using essentially the same connections, but using different instrumentation. The following paragraphs describe the basic parameters which may be tested.

4.2.2 Regulation checks: Since regulation of modern power supplies can be as low as 0.001%, special measuring techniques must be employed to accurately check the various regulation parameters. It is necessary to use an external source of DC voltage of approximately the same value as the power supply output as a "bucking" source, connected as shown in Figure 4-2. This DC bucking voltage can be either an electronic, null balance differential voltmeter, or a group of of batteries connected in series (or another power supply), furn-

ishing a DC potential slightly larger than the output voltage of the power supply under test. When using a differential voltmeter, the voltmeter is built right into the test equipment. When a "bucking" battery is used, the voltmeter should have a full-scale range low enough to detect the magnitude of regulation expected.

A multi-tester used on the 1 volt range will usually be adequate, since approximately 10 millivolts can be observed reasonably well. The point to note here is that the voltmeter is used to measure only the difference between two almost equal voltages. The balance adjustment (either in the electronic unit, or the test set-up of the diagram) is used to bring the meter needle to approximately midscale before testing, so that the deviation above or below normal output of the supply under test can be observed.

4.2.3 Static Load Regulation: The dummy load (R1) of Figure 4-2 is selected to draw full load current at the nominal output voltage of the supply. The difference between the differential voltmeter readings with the switch open and closed (allowing the needle to come to rest before reading), gives the static load regulation in volts. When load changes are made, it may be necessary to readjust the line voltage to its nominal value.

4.2.4 Static Line Regulation: With the load set at some fixed value, either no load, full load, or some in-between point, the input line is varied by means of the variable auto-transformer shown in Figure 4-2. Note that if this measurement is made under a heavy load condition, the auto-transformer must be selected to supply the necessary input volt-amperes. The difference between the differential voltmeter reading for different line voltage conditions (allowing the needle to

come to rest before reading), gives the static line regulation in volts.

4.2.5 Ripple: Either a sensitive VTVM or oscilloscope may be connected directly across the power supply sensing terminals for this measurement. The same set-up is used for the regulation checks may be used if it is desired to observe the ripple under different conditions of the voltage and load current. Be sure to make the measurement connections at the sensing terminals rather than at the load terminals.

4.2.6 Dynamic Regulation and Recovery Time: In the test set-up described above for Static Load or Line Regulation, a calibrated oscilloscope should be substituted for the differential voltmeter. Maximum deflection and recovery time are measured directly, as a dummy load of appropriate value is switched in and out of the circuit. A mercury switch is recommended to minimize arcing, or else an electronic switch should be used. If available,

the latter is highly desirable, since the response is readily displayed on the oscilloscope. If the rise and fall time of the current step be at least five times faster than the anticipated recovery time.

4.2.7 Stability: A detailed check for improper drift and intermittent failure can be made by utilizing the same test arrangement as for static regulation measurements. The only requirement is that the differential voltmeter used must have stability of an order of magnitude better than that of the power supply. If available, a stable recorder may be substituted for the differential voltmeter in the drawing, thereby procuring a continuous tracing of the power supply stability.

4.3 ALIGNMENT AND ADJUSTMENT:

The power supply has two controls that are factory adjusted and normally do not require attention in the field. If any of the components in the error-difference amplifier are replaced, the following readjustments

may be necessary.

4.3.1 OUTPUT ADJUST calibration:

Step 1: Set OUTPUT ADJUST variable resistors (R2) and (R3) completely clockwise. The unit may be operated at nominal line and at no load.

Step 2: Place calibrated voltmeter across output.

Step 3: Adjust variable resistor (R10) until full rated output voltage is reached.

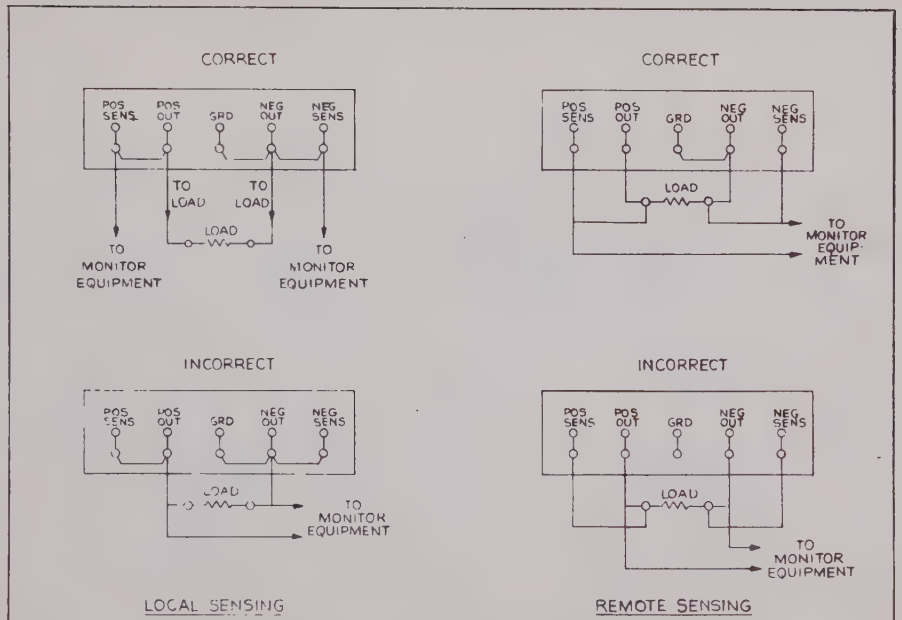
4.3.2 CURRENT ADJUST calibration:

Step 1: Set OUTPUT ADJUST variable resistors (R2) and (R3) completely clockwise. Verify that the output is the full rated voltage.

Step 2: Set CURRENT ADJUST variable resistor (R1) completely clockwise.

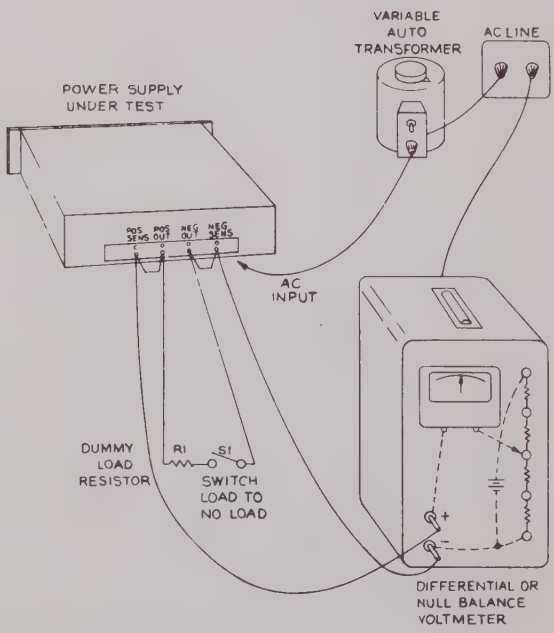
Step 3: Apply a short circuit to power supply through external current monitor.

Step 4: Slowly rotate variable resistor R13 until current level reaches the 110% limit.



MEASUREMENT CONNECTIONS WITH LOCAL SENSING AND REMOTE SENSING

801580 FIG. 4-1 103881



REGULATION CHECK
TYPICAL LAYOUT

FIG. 4-2

103880

801581

REVISIONS		
LTR	DESCRIPTION	DATE (YR/MO/DA)
A	ECN B 0244	0968
B	ECN B0332	9-9-68

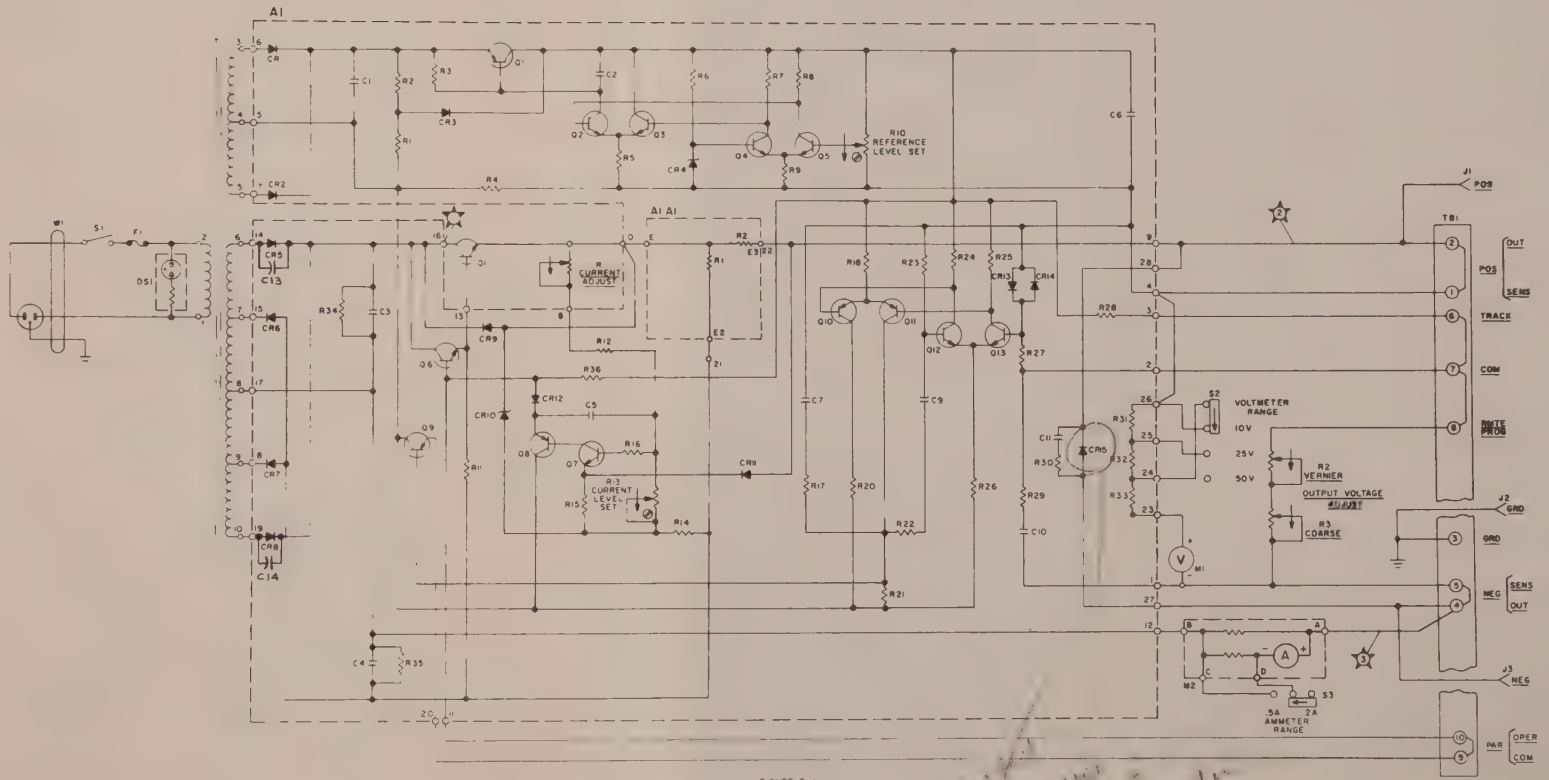


FIGURE 5-1
SCHEMATIC DIAGRAM

404025

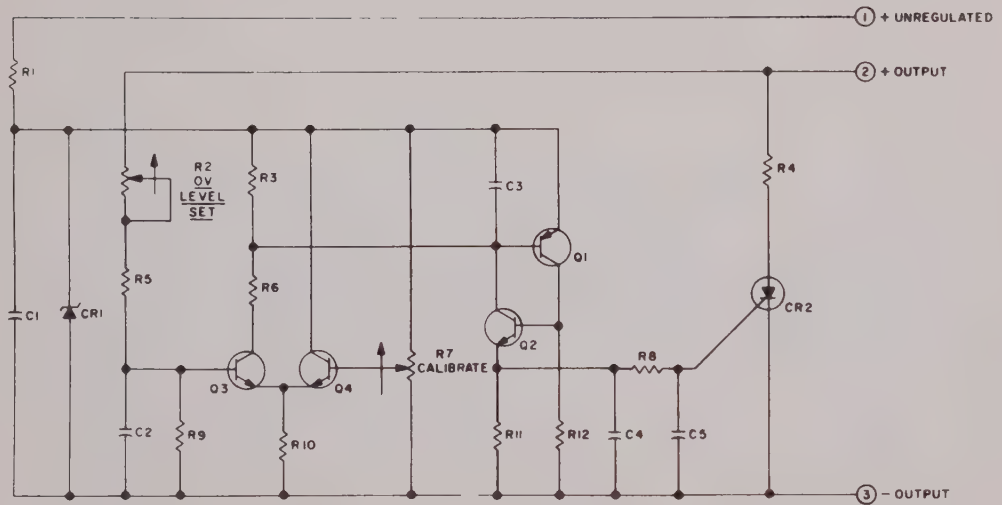


FIGURE 5-2
OVERVOLTAGE SCHEMATIC DIAGRAM

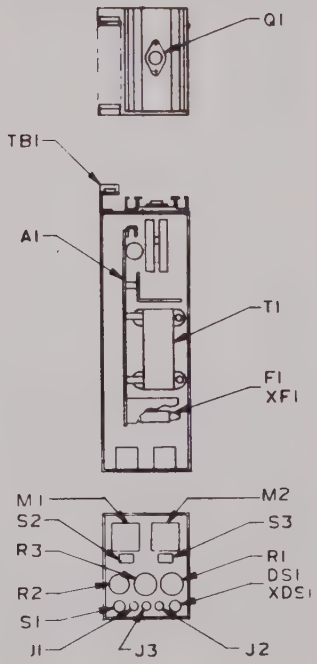


FIG 5-3A

NJE CORPORATION KENILWORTH, N. J.	SIZE A	CODE IDENT NO. 98380	DWG NO. 112131
	SCALE NONE	REV —	SHEET 2 OF 2

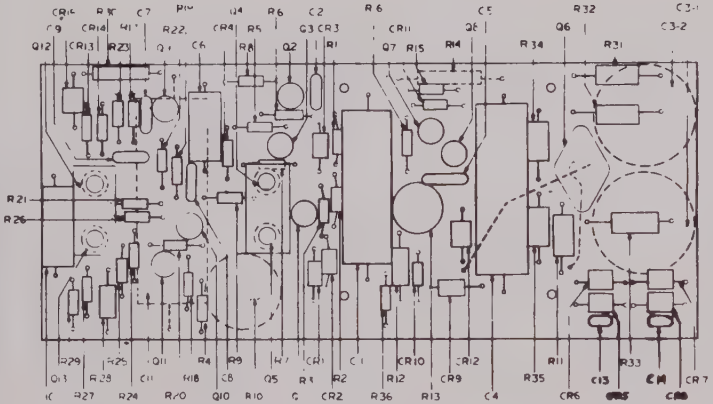


FIG 5-3B

NJE CORPORATION	SIZE	CODE IDENT NO.	DWG NO.
KENILWORTH, N.J.	A	98380	112120
SCALE NONE	REV —		SHEET 2

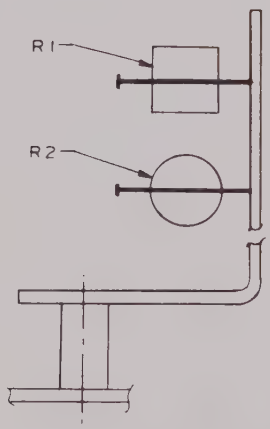


FIG 5-3C

NJE CORPORATION KENILWORTH, N. J.	SIZE A	CODE IDENT NO 98380	DWG NO 112132
	SCALE 1/4	REV	SHEET 2 OF 2

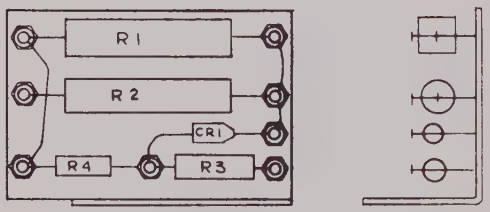


FIG-5-3C

NJE CORPORATION KENILWORTH, N. J.	SIZE A	CODE IDENT NO 98380	DWG NO 11130
	SCALE	REV A	SHEET 3 of 3

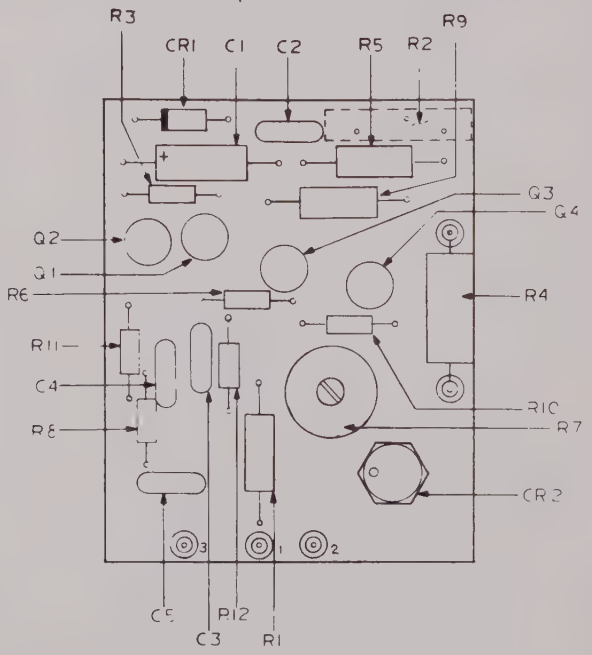


FIG. 5-3D

NJE CORPORATION KENILWORTH, N. J.	SIZE A	CODE IDENT NO 98380	DWG NO 112158
	SCALE	REV	SHEET

ABBREVIATIONS USED IN SPARE PARTS LIST

In DESCRIPTION Column: "SA" is used to mean "Same As" and "PO" is used to mean "Part Of". Where these symbols are used, the UNIT QTY., SPARE QTY., UNIT PRICE and NJE PART NO., columns are all blank.

In VALUE Column: The use of the letter "R" to indicate a decimal point is illustrated by the following examples: 5.6Ω is written as 5R60K. 1/2 watts is written as R500W. The use of zeroes does not imply a precision to the indicated number of decimal places but is a requirement of the proper handling of the Data Processing Cards from which these spare parts lists are written.

The standard symbols for electrical units are used and usually appear in the columns immediately to the left of the dashed and solid lines in the Value field. In all cases, the symbol "Ω" is not printed for resistors and is understood. For example: 200Ω is written 200 and 2.7MΩ is written 2R70M.

In REFERENCE DESIGNATION Column: The reference designations are those which interrelate the Spare Parts List, the Schematic Diagrams and the Parts Placement drawings. The symbols are those of MIL-STD-16. Where the reference designation is an "A" (meaning a sub-assembly), a Spare Parts

List bearing the NJE Part Number of that assembly is included in the Spare Parts List section.

Deviations: Where minor deviations are accomplished by modifying a standard unit, a Spare Parts List which only shows the deletions and additions from the enclosed standard Spare Parts List is used.

N J E Corp. KENILWORTH, N.J.

Spare Parts List

MODEL LVC 50-0.5 111803 PAGE NO. 1 of 1

REFERENCE DESIGNATION	DESCRIPTION VENDOR NAME*	RATINGS VENDOR PART NO.*	NJE PART NO.	QTY USED	SPARE QTY.	UNIT PRICE
A1	CKT. CARD ASSY	CIRCUIT CARD	111829	1	1	
C1	NOT USED					
DS1	LAMP NEON	1/3W 125V	520974	1	1	1.50
F1	FUSE CARTRIDGE	1A 125V	206	1	5	.25
J1	CONN. RECEPT.	1 PIN 15A	20667	1	1	1.00
J2	CONN. RECEPT.	1 PIN 15A	20668	1	1	1.00
J3	CONN. RECEPT.	1 PIN 15A	5640	1	1	1.00
M1	METER, VOLT D.C.	10-25-50V 1MA	111918	1	1	40.00
M2	METER, AMP D.C.	.5-2A 25MV	111935	1	1	40.00
Q1	XISTOR, NPN SI	117W 160V	5435	1	1	6.00
R1	RES. VAR. W.W.	1.0K 2W	111813	1	1	4.75
R2	RES. VAR. W.W.	50.00 2W	111826	1	1	3.95
R3	RES. VAR. W.W.	5.0K 2W	111815	1	1	4.75
S1	SWITCH, SPST	3A 250VAC	111827	1	1	2.15
S2	SWITCH, SLIDE	3P3P 1ADC	111950	1	1	2.15
S3	SWITCH, SLIDE	SPDT 1ADC	111951	1	1	1.90
T1	XFORMER	XFORMER	209801	1	1	38.75
TB1	TERMINAL BOARD	10 TERM 15A	112445	1	1	2.50
TB2	TERMINAL BOARD	2 TERM 5A	5627	1	1	.50
W1	LINE CORD	3 WIRE 6 FEET	111828	1	1	3.75
XDS1	NOT USED					
XF1	FUSE HOLDER	30A 250V	112388	1	1	.20

*SPARE PARTS LIST SPECIFYING TYPICAL VENDOR'S NAME AND PART NUMBER IS AVAILABLE ON SPECIAL ORDER ONLY.

1 - When ordering spare parts it is necessary to specify the serial number and model number (available on the warranty label on the rear of the unit) and the NJE Part No. from this spare parts list.
2 - Unit Price shown above is subject to change without prior notice
3 - NJE Corp reserves the right to make design improvements on this unit without prior notice.
4 - Spare Quantity shown above is recommended quantity for one year isolated service.

REV	ECN	DATE
A	B-245	1-15-65
B	P 1	12-1-65
C	B-260	2/6/67

N J E Corp. KENILWORTH, N.J.

Spare Parts List

MODEL CIRCUIT CARD ASSY P/N 111829

REFERENCE DESIGNATION	DESCRIPTION VENDOR NAME*	RATINGS VENDOR PART NO.*	NJE PART NO.	QTY. USED	SPARE QTY.	UNIT PRICE
A1	RESISTOR ASSY	RESISTOR ASSY	209034	1	1	
C1	CAP. FXD. ELECT.	260UF 30V	P6373	1	1	3.95
C2	CAP. FXD. FILM	.001UF 250V	111968	2	1	2.00
C3	CAP. FXD. ELECT.	700UF 100V	111823	1	1	3.75
C4	CAP. FXD. ELECT.	80UF 75V	P4903	1	1	3.75
C5	S/A C2					
C6	CAP. FXD. ELECT.	15UF 35V	P5051	1	1	3.15
C7	CAP. FXD. FILM	.01UF 250V	5483	3	1	1.50
C8	NOT USED					
C9	CAP. FXD. FILM	.0047UF 250V	111969	1	1	1.50
C10	CAP. FXD. ELECT.	32 UF 64V	5654	1	1	2.00
C11	CAP. FXD. ELECT.	300UF 75V	P6007	1	1	3.75
C12	NOT USED					
CR1	DIODE RECT.	750MA 400V	503986	13	4	2.50
CR2	S/A CR1					
CR3	S/A CR1					
CR4	DIODE ZENER	400MW 5.1V	P4281	2	2	3.75
CR5	S/A CR1					
CR6	S/A CR1					
CR7	S/A CR1					
CR8	S/A CR1					
CR9	S/A CR1					
CR10	S/A CR4					
CR11	S/A CR1					

*SPARE PARTS LIST SPECIFYING TYPICAL VENDOR'S NAME AND PART NUMBER IS AVAILABLE ON SPECIAL ORDER ONLY

1 - When ordering spare parts it is necessary to specify the serial number and model number (available on the warranty label on the rear of the unit) and the NJE Part No. from this spare parts list

2 - Unit Price shown above is subject to change without prior notice.

3 - NJE Corp. reserves the right to make design improvements on this unit without prior notice

4 - Spare Quantity shown above is recommended quantity for one year isolated service

REV	ECN	DATE
A	80992	1/26/68

MODEL CIRCUIT CARD ASSY P/N 111829 PAGE NO. Page 2

REFERENCE DESIGNATION	DESCRIPTION VENDOR NAME*	RATINGS VENDOR PART NO.*	NJE PART NO	QTY. USED	SPARE QTY	UNIT PRICE
CR12	S/A CR1					
CR13	S/A CR1					
CR14	S/A CR1					
CR15	S/A CR1					
Q1	XISTOR. PNP SI	1W 50V	111945	1	1	5.25
Q2	XISTOR. NPN SI	200MW 25V	5650	7	2	3.00
Q3	S/A Q2					
Q4	S/A Q2					
Q5	S/A Q2					
Q6	XISTOR.NPN SI	25W 160V	5434	1	1	3.75
Q7	S/A Q2					
Q8	XISTOR. PNP SI	200MW 25V	111529	4	2	2.95
Q9	S/A Q8					
Q10	S/A Q8					
Q11	S/A Q8					
Q12	S/A Q2					
Q13	S/A Q2					
Q14	NOT USED					
R1	RES. FXD. COMP.	680.00 .500W	1021	1	1	.20
R2	RES. FXD. COMP.	510.00 .500W	20664	1	1	.20
R3	RES. FXD. COMP.	150.00 .500W	55	1	1	.10
R4	RES. FXD. COMP.	47.00 .500W	178	1	1	.10
R5	RES. FXD. COMP.	820.00 .500W	59	2	1	.10
R6	RES. FXD. COMP.	220.00 .500W	179	3	1	.10

*SPARE PARTS LIST SPECIFYING TYPICAL VENDOR'S NAME AND PART NUMBER IS AVAILABLE ON SPECIAL ORDER ONLY.

1 - When ordering spare parts it is necessary to specify the serial number and model number (available on the warranty label on the rear of the unit) and the NJE Part No. from this spare parts list.
2 Unit Price shown above is subject to change without prior notice
3 NJE Corp. reserves the right to make design improvements on this unit without prior notice
4 Spare Quantity shown above is recommended quantity for one year isolated service

N J E Corp. KENILWORTH, N.J. — Spare Parts List

MODEL CIRCUIT CARD ASSY P/N 111829 PAGE NO 3

REFERENCE DESIGNATION	DESCRIPTION VENDOR NAME*	RATINGS VENDOR PART NO.*	NJE PART NO	QTY USED	SPARE QTY	UNIT PRICE
R7	RES. FXD. COMP.	2.20K .500W	346	3	1	.10
R8	S/A R7					
R9	S/A R7					
R10	RES. VAR. W. W.	2.0K 2W	111816	1	1	4.75
R11	RES. FXD. COMP.	10.00K 2W	1083	3	1	.20
R12	RES. FXD. COMP.	68.00 .500W	470	1	1	.10
R13	RES. VAR. W. W.	5.0K 2W	111818	1	1	3.75
R14	RES. FXD. W. W.	4.70K 5W	111971	1	1	2.25
R15	RES. FXD. COMP.	4.70K .500W	186	1	1	.20
R16	RES. FXD. COMP.	1.0K .500W	60	2	1	.10
R17	RES. FXD. COMP.	330.00 .500W	180	1	1	.10
R18	S/A R5					
R19	NOT USED					
R20	RES. FXD. COMP.	1.50K .500W	61	1	1	.20
R21	RES. FXD. COMP.	10.00K .500W	66	1	1	.10
R22	RES. FXD. COMP.	15.00 .500W	177	1	1	.10
R23	S/A R6					
R24	RES. FXD. COMP.	3.90K .500W	63	2	1	.10
R25	S/A R24					
R26	S/A R16					
R27	S/A R6					
R28	RES. FXD. FILM	887.00 1W	111972	1	1	3.15
R29	RES. FXD. COMP.	27.00 .500W	461	1	1	.10
R30	RES. FXD. W. W.	30 3W	111973	1	1	1.50

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N J E Corp. KENILWORTH, N.J. — Spare Parts List

MODEL CIRCUIT CARD ASSY P/N 111829 PAGE NO 4

REFERENCE DESIGNATION	DESCRIPTION VENDOR NAME*	RATINGS VENDOR PART NO *	NJE PART NO	QTY USED	SPARE QTY	UNIT PRICE
R31	RES. FXD. FILM	25.00K 1W	111922	1	1	1.75
R32	RES. FXD. FILM	15.00K 1W	111921	1	1	1.75
R33	RES. FXD. FILM	9975.00 1W	111920	1	1	1.75
R34	S/A R11					
R35	S/A R11					
R36	RES. FXD. COMP.	3.30K .500W	1025	1	1	.20
XQ1	SOCKET, XISTOR	4 PIN	128	12		.75
XQ2	S/A XQ1					
XQ3	S/A XQ1					
XQ4	S/A XQ1					
XQ5	S/A XQ1					
XQ6	NOT USED					
XQ7	S/A XQ1					
XQ8	S/A XQ1					
XQ9	S/A XQ1					
XQ10	S/A XQ1					
XQ11	S/A XQ1					
XQ12	S/A XQ1					
XQ13	S/A XQ1					
C13	S/A C7					
C14	S/A C7					

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N J E Corp. KENILWORTH, N.J.

Spare Parts List

MODEL RESISTOR ASSY P/N 209034 PAGE NO. 1 of 1

REFERENCE DESIGNATION	DESCRIPTION VENDOR NAME*	RATINGS VENDOR PART NO.*	NJE PART NO.	QTY. USED	SPARE QTY.	UNIT PRICE
R1	RES. FXD. W. W.	3.0K 10W	111974	1	1	2.15
R2	RES. FXD. W. W.	2.0 10W	501728	1	1	1.75

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4 - Spare Quantity shown above is recommended quantity for one year isolated service.

Our Warranty:

N J E Corporation warrants all power supplies manufactured by it, to be free from defects in material or workmanship. Our liability, under this warranty, is limited to servicing, or adjusting any instrument returned to the factory or to an N J E field service center for that purpose, and to replacing any defective parts thereof. This warranty is made to the original purchaser and applies to all standard catalogue listed equipment for ten years after delivery to the original purchaser. The provisions of this warranty shall not apply to any power supply which has been subject to misuse or which has been repaired or altered by the purchaser in any way so as, in the judgment of N J E Corporation, to adversely affect its performance or reliability, nor to normal deterioration of appearance due to wear or exposure.

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